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What Is Alcohol per Capita Consumption of Adults Telling us about Drinking and Smoking among Adolescents? A Population-Based Study across 68 Countries

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Abstract — **Aims:** To investigate whether recorded alcohol per capita consumption of adults could be linked with alcohol drinking and smoking among adolescents. **Methods:** Adult alcohol per capita has been plotted graphically together with the prevalence of current drinking and smoking among adolescents. **Results:** Across all 68 countries, a highly statistically significant correlation was detected, indicating a linear relationship. **Conclusion:** Countries which are high in alcohol per capita consumption among adults need to pay heightened attention to alcohol and tobacco use among the younger population.

INTRODUCTION

Globally, consumption of alcohol among adults (WHO, 2004) as well as among adolescents (Anon, 2008) is increasing, inducing a rising alcohol-attributable burden, leading to high social and economic costs (Rehm *et al.*, 2009). Currently, alcohol is the most used psychoactive substance worldwide with substance use in low- and middle-income countries likely to rise over the coming decades (Rehm *et al.*, 2003; WHO, 2004). Data from the WHO Global Status Report on Alcohol show that across all countries and regions of the world, a wide variation in the volume of alcohol consumption exists, with average adult per capita consumption ranging from 0 up to 18 l of pure alcohol worldwide (WHO, 2004). As for adults, alcohol use and cigaret smoking among adolescents is not cross-culturally stable (Hibell *et al.*, 2004; Schmid *et al.*, 2003; Warren *et al.*, 2008). According to the European School Survey Project on Alcohol and Other Drugs (ESPAD) conducted among 15–16-year olds, alcohol and cigaret prevalence rates in the past 30 days preceding the survey vary considerably between European countries showing prevalence rates from 20 to 82% for alcohol, and 18 to 60% for cigaret smoking (Hibell *et al.*, 2004). Among low- and middle-income countries in Africa and the Americas as investigated by the WHO Global School-based student Health Survey (GSHS), current drinking among adolescents ranges from around 3 to 62% in Africa, and from 14 to 60% in the Americas. Similarly, for current smoking, prevalence rates range from around 4 to 17% among adolescents in Africa, and from around 7 to 30% in the Americas (Information on GSHS data/GSHS fact sheets available at <http://www.who.int/chp/gshs/factsheets/en/index.html>). A variety of factors with complex and multiple levels of influence may determine the substance use among adults and adolescents. Among adolescents, psychoactive substance use may be explained by broader contextual macro-level factors like gross domestic product of the country, poverty and cultural factors such as religion (Elgar *et al.*, 2005; Kuntsche and Kuendig, 2005; Turner *et al.*, 2004; WHO, 2006), by meso-level factors such as school

(Allison *et al.*, 1999; Anderson *et al.*, 2006; Pinilla *et al.*, 2002), family (Borawski, *et al.*, 2003; Scholte *et al.*, 2008) and peers (Gilvarry, 2000; Piko, 2006), as well as by individual-level factors such as personality and genetics (Cooper *et al.*, 2003; McGue and Iacono, 2008). Risk behaviors such as psychoactive substance use often tend to cluster, and alcohol is often consumed together with other psychoactive substances such as tobacco, a phenomenon which has been reported across different countries (Anthony and Echeagaray-Wagner, 2000; Faeh *et al.*, 2006; Schmid *et al.*, 2007). Although estimates of adult (15+ years) alcohol per capita consumption are available for the majority of WHO Member States, at the global level, no study has ever explored the association between adult alcohol consumption and current drinking and smoking among adolescents. Therefore, the current exploratory study was conducted to evaluate on a global scale whether recorded alcohol per capita consumption of adults is linked with the level of reported alcohol drinking and smoking among adolescents, testing the association across 68 countries in the world.

METHODS

Data on recorded alcohol per capita consumption of adults (15+ years) are for 2003 and were obtained from the WHO Global Information System on Alcohol and Health (GISAH, available at <http://apps.who.int/globalatlas/default.asp>). Recorded alcohol per capita consumption is available for almost all WHO Member States and its territories, with 2003 data being the most recent year of comprehensive data. Recorded alcohol per capita consumption of adults reflects the consumption of pure alcohol per person per country in a given year, and is computed from government records (taxation), industry publications for the production and sales of alcohol as well as data from the UN Food and Agricultural Organization (Rehm *et al.*, 2009). If multiple data sources for a country exist, a choice in favor of the most reliable and accurate data is always made when recorded adult (15+

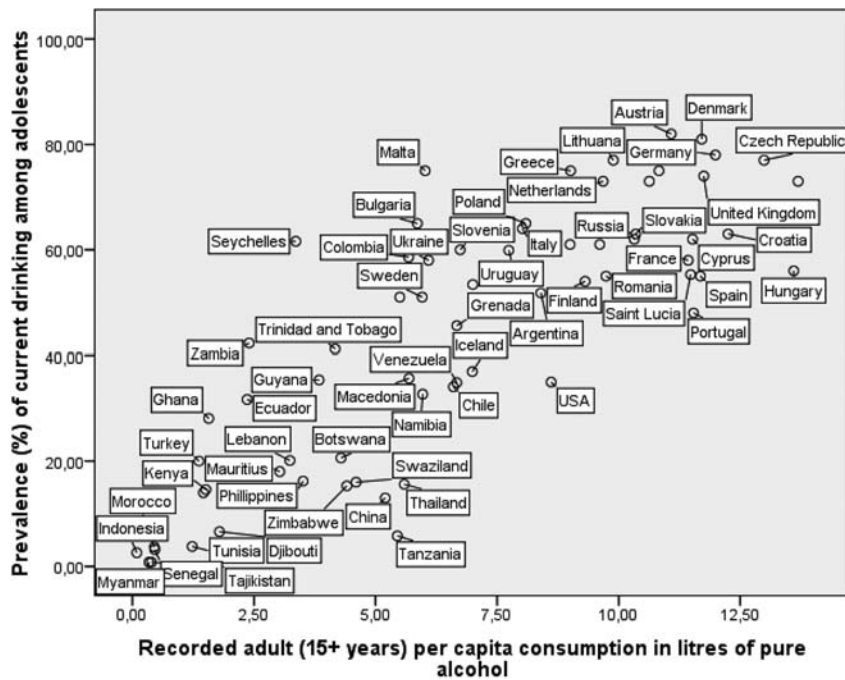


Fig. 1. Recorded alcohol per capita consumption of adults and current drinking among adolescents.

years) per capita consumption is estimated (WHO, 2004). Recorded adult (15+ years) per capita consumption is reflecting the official statistics of the country, and does, therefore, not include estimates on unrecorded alcohol consumption. Unrecorded alcohol consumption may include traditional alcoholic beverages and alcohol stemming from home production, travelers imports and cross-border shopping, smuggling, and alcohol intended for industrial, technical and medical uses (WHO, 2004).

Prevalence rates of 15–16-year-old adolescents of drinking and smoking in the past 30 days in countries belonging to the WHO European Region were extracted from the 2003 ESPAD (Hibell *et al.*, 2004), one of the largest international studies collecting information on substance use among youth (Plant and Miller, 2001). Prevalence rates on current drinking and smoking among adolescents from the USA were also taken from the ESPAD study. Data on drinking and smoking (past 30 days prevalence rate) among 13–15-year olds from countries in the WHO African Region, the WHO Region of the Americas, the WHO Eastern Mediterranean Region, the WHO South-East Asia Region and the WHO Western Pacific Region were compiled from the WHO GSHS country fact sheets (WHO GSHS, 2010) (fact sheets available at <http://www.who.int/chp/gshs/factsheets/en/index.html>). The WHO GSHS is an international collaborative surveillance project collecting information about the leading causes of mortality and morbidity among adolescents in low- and middle-income countries, employing a common school-based methodology, with a self-administered questionnaire. GSHS data from the countries used in this study were collected between 2003 and 2008, with data collection having taken place between 2003 and 2005 for half of the countries, and between 2006 and 2008 for the other half of the countries presented in this study. ESPAD and GSHS employ the same questions to assess prevalence of current drinking and current smoking among adolescents (i.e. alcohol use and

cigarette smoking in the past 30 days preceding the survey). Using a standardized scientific sample selection process, data on current drinking and current smoking among adolescents stemming from the ESPAD and GSHS are representative for the country as a whole. In single cases, however, GSHS data are applying to specific regions or towns only ('Chile' is referring to the Metropolitan Region only; 'China' is referring to Beijing; 'Colombia' to Bogota; 'Ecuador' to Quito; 'Mauritius' to Mauritius without Rodrigues; 'Tanzania' to Dar Es Salaam; 'Venezuela' to Barinas and 'Zimbabwe' to Harare only).

To present recorded alcohol per capita consumption of adults together with prevalence of current drinking or smoking in adolescents, respectively, the data were graphically plotted using SPSS 15.0 (Fig. 1: Recorded alcohol adult per capita consumption/Current drinking among adolescents; Fig. 2: Recorded alcohol adult per capita consumption/Current smoking among adolescents). To show the strength of the relationship, Pearson's correlation coefficients and the explained variances between alcohol adult per capita consumption and adolescents' substance use were computed.

RESULTS

The majority of countries which are high in recorded alcohol adult per capita consumption tended to show higher rates of current drinking and higher rates of current smoking among adolescents (Figs. 1 and 2, respectively). The strength of the relationship between recorded adult alcohol per capita consumption and current drinking among adolescents was stronger than for current smoking. Across all countries, Pearson's correlation coefficient revealed a statistically significant association between recorded adult per capita alcohol consumption and current drinking among adolescents of $r=0.81$ ($P<0.001$; explained variance: 65%), and a correlation of

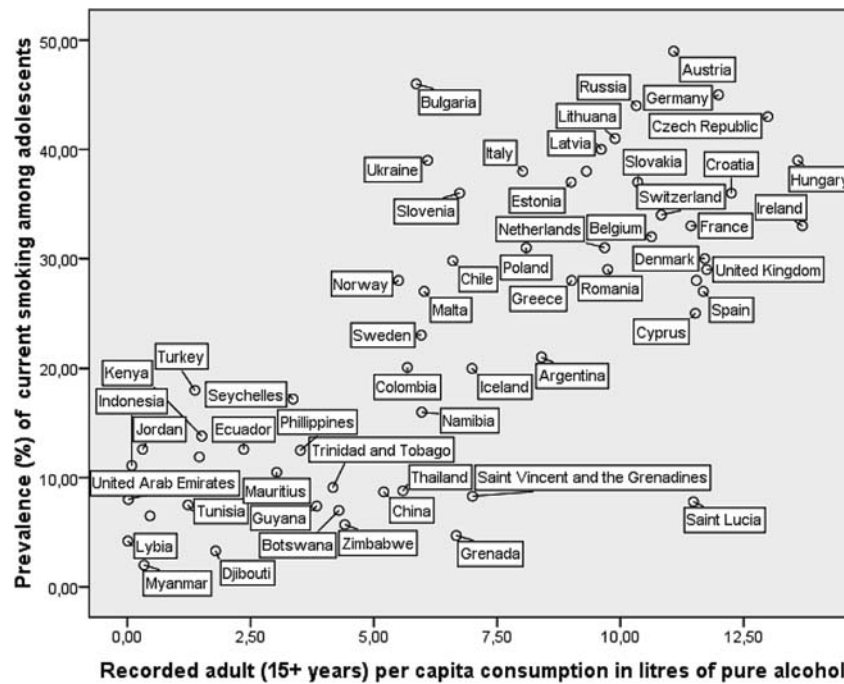


Fig. 2. Recorded alcohol per capita consumption of adults and current smoking among adolescents.

$r = 0.74$ ($P < 0.001$, explained variance: 55%) between recorded alcohol adult per capita consumption and current smoking among adolescents, respectively.

DISCUSSION

Countries which rank higher in recorded per capita alcohol consumption of adults are more likely to score higher in terms of prevalence of adolescents drinking and smoking, a finding seen across different countries and regions. To the best of our knowledge, this is the first international study demonstrating a strong association between alcohol consumption of adults and drinking and smoking among adolescents at a population level. This study is supported by other ecological research. For example, state-by-state analyses conducted in the US report similar findings, and show that youth estimates of current drinking and binge drinking are as well moderately to strongly correlated with adult alcohol use and adult drinking-driving behaviors (Nelson *et al.*, 2009).

Cause and effect cannot be determined with this kind of study; however, reverse causality implying that alcohol use and cigaret smoking among adolescents influences the level of recorded adult per capita consumption is unlikely at a cross-sectional level at a single point in time. Nevertheless, with this kind of study design causal pathways cannot be revealed, and the study does not support the assumption that adolescent drinking and smoking rates are due to alcohol per capita consumption of adults only. With the assumption of causal pathways one would fall into the trap of the ecological fallacy, leading to an error in statistical interpretation of data.

The correlation between recorded alcohol per capita consumption among adults, and adolescents drinking and smoking, might arise due to shared risk factors. Though predictors may be complex, on the ecological level, wealth of the country (i.e. gross domestic product; Rehm, *et al.*, 2009)

positively related to alcohol use, and different socio-cultural factors of society (WHO, 2006), may constitute important structural factors influencing the level of recorded adult per capita consumption among adults and forming ultimately as well the level of substance use among adolescents. In addition, the correlations might be explained through alcohol policies which are in place across societies, or even prohibitions of the manufacture, import, export and sale of alcoholic beverages as seen in some Eastern-Mediterranean or Muslim countries, having an effect on alcohol consumption of the population as a whole. Policies regulating the context in which alcohol is consumed (such as the implementation of a minimum purchase age, existence of government monopolies over sales, outlet density and days/hours of sales in countries, volume of alcohol advertising, implementation of alcohol service laws and level of pricing policies) are effective means of reducing alcohol-related harm and consumption (Anderson *et al.*, 2009). Restricted accessibility of alcohol through different policy measures might hinder and constrain consumption, especially among adolescents if policy measures are effectively enforced. Furthermore, there is the possibility that the association between adult alcohol per capita consumption and cigaret use among adolescents is also affected by the presence or absence of alcohol policies in countries as interdependencies exist. Public health benefits of alcohol policies on cigaret use have been observed and research indicates that alcohol and cigalets (Busch *et al.*, 2004; Decker and Schwartz, 2000), but also alcohol and other psychoactive drugs such as marijuana (Williams *et al.*, 2004) are complements rather than substitutes, meaning that alcohol policies leading to higher prices of alcoholic beverages may decrease smoking rates. Similarly, synergistic effects between cigaret use and alcohol consumption have been reported as well, with the introduction of cigaret taxes yielding in a reduction of alcohol use in the population (Lee, 2007).

Some limitations of the study have to be laid out. Firstly, analyses between recorded adult (15+ years) per capita consumption and prevalence of adolescents drinking and smoking are crude, and additional unexplored variables like poverty or socio-economic status of the country as well as different alcohol policies and restrictions as described above may contribute to the strength of the association. Secondly, unrecorded alcohol consumption of the respective countries was not taken into account, and the associations between adult per capita consumption and prevalence of adolescents drinking and smoking were analyzed with recorded alcohol per capita consumption only. Traditional alcoholic beverages such as palm wine or sorghum are in the majority of cases consumed by rural people and among the poor and may contribute significantly to total alcohol per capita consumption (Patel, 2007; Obot, 2007). Unrecorded alcohol consumption varies to the extent to which it contributes to total alcohol per capita consumption across countries, however, as it is present in almost every society (WHO/GISAH, 2010), we do not expect that the association between adult alcohol consumption and prevalence of current drinking and smoking among adolescents is biased to a great extent. Thirdly, the ESPAD and GSHS study are school-based surveys, and data on adolescents not attending schools could, therefore, not be incorporated. Students who do not go to school or who are absent on the day of the survey may differ from those being at school and may present higher substance use prevalence rates (Bovet *et al.*, 2006). School surveys are often times, however, the only possible way to capture data on the adolescent population, taking limits in external validity of the sample into account. Further, this study presenting the association between adult (15+ years) per capita alcohol consumption and prevalence of adolescents' substance use covering a range of countries could only be pursued with using two different adolescent surveys as there is no single global surveillance system in place collecting data on substance use among adolescents across countries and different regions of the world. Therefore, the reference period of data collection as well as the age range of the adolescents between the two surveys differs with the slightly younger adolescent group coming in the majority of cases from low- and middle-income countries. Comparability of the prevalence rates between the two surveys as well as the area of reference of alcohol per capita consumption and prevalence of adolescents drinking and smoking in Chile, China, Colombia, Ecuador, Mauritius, Tanzania, Venezuela and Zimbabwe in which not the whole adolescent population in the country has been analyzed might therefore be constrained. However, age ranges between the two surveys are overlapping so that discrepancies regarding adolescent drinking and smoking prevalence rates should be small.

The great strength of the current study is that for the first time an association between recorded adult per capita consumption and the prevalence of current drinking and current smoking among adolescents has been proved, showing this association globally among a very large group of countries. Further studies on the potential causal pathways between a society's alcohol consumption of adults and drinking and smoking among adolescents are greatly needed. Despite some of the limitations of the study, our results cannot deny the fact that alcohol consumption of society fulfills a task in adolescents' substance use. As the relationship between

recorded alcohol per capita consumption of adults and prevalence of drinking and smoking among adolescents is closely linked and linear across a variety of countries in the world, we conclude that in the design of preventive approaches tackling drinking and smoking among the younger population group at the societal level through public health, policy and practice measures, recorded alcohol adult per capita consumption should be considered in addition. Countries which are already high in adult alcohol per capita consumption need to pay heightened attention to drinking and smoking among the younger population.

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